Assessment of Biomass Burning on the Hydrologic Cycle of the Amazon

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Research into estimating total column atmospheric water vapor from infrared sensors onboard satellites has been a focus of research at MSFC for a number of years. Water vapor plays an important role in climate processes. It is a major element of the hydrologic cycle and provides the mechanism for energy exchange among many of the Earth system components. Recently, the Global Hydrology and Climate Center (GHCC) was contacted by researchers, Dr. Tracy DeLiberty and John Callahan, from the University of Delaware about joint research into quantifying the role that biomass burning is playing on the hydrologic cycle of the Amazon. The physical split window (PSW) technique will be used to estimate total precipitable water (i.e., total column water vapor) in the Amazon and surrounding areas. The technique was developed by MSFC's Dr. Gary Jedlovec.

The focus of this research is to examine the moisture budget in the Amazon using data from a variety of sources (e.g., satellite, model, and conventional surface and upper-air data), to determine the time-space variability of components of the hydrologic cycle, and to examine regional implications versus localized differences in forested versus deforested areas. Recent modeling and site-specific observational efforts have suggested that the effects of land cover change from biomass burning and deforestation may play a major role in the climate and hydrologic cycle. One of the most active regions of biomass burning and deforestation is located in South America, yet very little is known concerning the environmental implications of these activities in the Amazon Basin.

Two particular months, June and October (months prior to and following the peak biomass burning and deforestation activities in the Amazon) are under current investigation during 1988 and 1995. Rainfall rates, total precipitable water, and land surface temperature changes are being calculated from Geostationary Operational Environmental Satellite (GOES–7), Visible Infrared Spin Scan Radiometer (VISSR), Atmospheric Sounder (VAS), and GOES–8 Imager, while the vegetation state is characterized from the National Oceanic and Atmospheric Administration (NOAA) Advanced Very High Resolution Radiometer (AVHRR) vegetation index. Conventional data (e.g., raingage and hydrologic data) is being used to verify and supplement satellite-derived parameters of the hydrologic cycle. The study will provide a regional view of the moisture cycle, document the variability across the region, investigate the enhanced capabilities of GOES–8 versus GOES–7, and evaluate the possible hydrological signatures associated with deforestation activities. This research began as part of Dr. DeLiberty's National Research Council Associate Programs at the University of Wisconsin, and she continues collaboration with researchers at the Center for Meteorological Satellite Studies. The aim is to extend the period of study to include several years to perform a trend analysis of the hydrologic cycle of the Amazon spanning a decade.

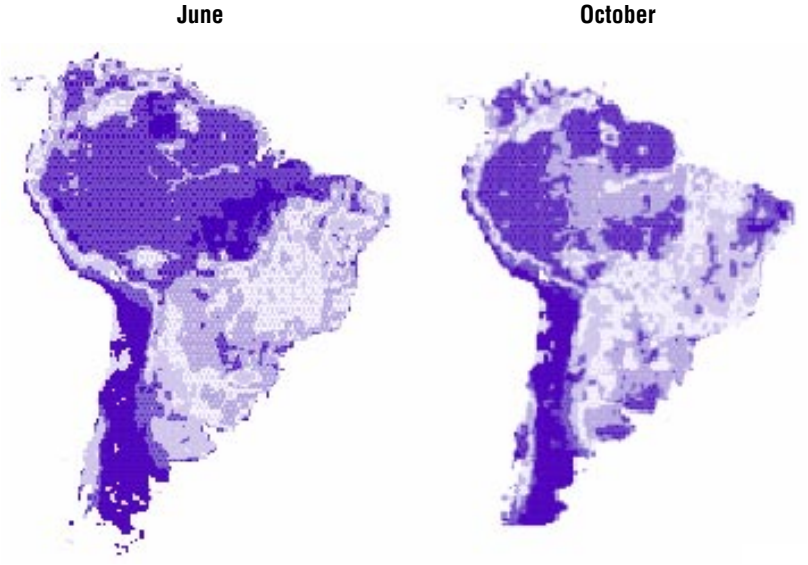

FIGURE 152.—Five-year climatology of Normalized Vegetation Index (NDVI) from AVHRR.

Specifically relating to the hydrologic component total precipitable water, researchers at the University of Delaware hope to enhance the PSW by improving the cloud filtering algorithm and incorporating the vegetation index which would vary spatially and temporally to provide a better estimate of surface emissivity.

Initial results from the examination of 1988 and 1995 will hopefully be submitted for publication early this winter.

Previous work of Dr. DeLiberty has entailed examination of the moisture budget, specifically with precipitation and soil moisture, in the Southern Great Plains. The GHCC scientists involved have focused on the evaluation of precipitable water algorithms and of infrared sensor capabilities.

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University of Delaware, Geography Department

Biographical Sketch: Anthony Guillory is an atmospheric scientist in the Earth System Science Division at MSFC's Global Hydrology and Climate Center. He conducts scientific research using measurements from satellites, aircraft, and ground-based systems to study the Earth's hydrologic cycle. Guillory earned his M.S. degree in meteorology from the Florida State University in 1991 and has worked for NASA for 5 years.